Nitrous oxide emission by Pastures in Integrated and Non-Integrated Beef Cattle Production Systems during Spring

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Introduction

Integrated livestock production systems are those in which pastures, crops and trees are, alternately or simultaneously cultivated in the same area. Integrated silvopastoral, crop- livestock and crop-livestock-forestry systems aim at higher levels of productivity as well as environmental, social and economic sustainability (VILELA, et al., 2011). To that end, the most appropriate alternative must maximize the use of available resources, improve soil quality - the base of agricultural production - and reduce the use of inputs, resulting in higher profitability (DORAN & PARKIN, 1994; SINGER & EWING, 2000).

The increasing emission of anthropogenic greenhouse gases (GHG), resultant of farming, energy production, disposal of residues and land use change is one of the greatest environmental problems. It is estimated that agriculture is responsible for 20% of total anthropogenic GHG emissions but it can also function as a carbon sink (JOHNSON et al., 2005). The reduction in GHG emissions, including nitrous oxide (N_2O), besides its importance in climate change, helps to reduce losses in livestock production, improving its efficiency (Oliveira et al., 2015). This study aimed at evaluating N_2O emissions in pastures under different managements, to better understand important beef cattle production systems in Brazil, specially the integrated systems.

Material and Methods

The study was carried out at Embrapa Pecuária Sudeste, SP (21°57'42"S, 47°50'28" W, 860 m) from 29/10/2013 to 19/11/2013. The climate is classified as Cwa (Köppen), with two well defined seasons: dry season - April to September, with average temperature and precipitation of 19.9ºC and 250 mm, respectively; rainy season - October to March, with average temperature and precipitation of 23.0ºC e 1,100 mm, respectively. The soil in the area is classified as Dystrophic Red Latosol. N_2O emission was evaluated in the Atlantic Forest (Forest) and in pastures belonging to five production systems: 1) Intensive (INT) - dryland rotational grazing system; 2) Integrated Silvopastoral System (SP) - rotational grazing with eucalyptus trees (15 x 2 m spacing); 3) Integrated Crop-livestock System (CL) - rotational grazing system with crop rotation in each paddock in four year cycles (three years with pasture and one year with corn); 4) Integrated Crop-livestock-forestry System (CLF) - the same as CL with eucalyptus trees (15 x 2 m spacing); 5) Extensive (EXT) - continuous grazing system. Soils in EXT and in an adjacent area of Atlantic Forest were used, respectively, as negative and positive controls.

Pastures in INT, SP, CL and CLF were established in 2012 with *Urochloa* (sin. *Brachiaria*) *brizantha* (Hochst ex A. Rich.) Stapf cv. Piatã and were fertilized with 50 kg of N ha^{-1} via urea, in each grazing cycle during the rainy season, amounting to 200 kg N ha^{-1} $year^{-1}$. Each of these systems had two replicate pasture areas, of 3 ha each, divided in six paddocks in a rotational system with six days of occupation and 30 days rest. The pasture in EXT was established in 2007 with *Urochloa* (sin. *Brachiaria*) *decumbens* (Stapf) R. Webster and was not fertilized. The EXT system had two pasture areas of 2.85 ha each managed under continuous grazing. The stocking rate was adjusted in all pastures using the "put and take" technique (Mott and Lucas, 1952) and visual evaluation of forage availability.

The experimental design was in blocks with repetitions. It was used two repetitions for each pasture area (blocks). Net flows of N_2O emissions were evaluated using air samples collected from cylindrical PVC "static chambers". The chamber body was 17cm height and 30 cm in diameter and was covered with insulating material. Six chambers were used per treatment (three per block or pasture area). Three chambers were also allocated in an Atlantic Forest area (positive control). A digital thermometer was adapted to each of the chambers for internal temperature measurement. Three collections of air samples were done in each chamber at 30 min intervals, with polypropylene syringes. Samples were taken between 8:00 and 10:00 a.m. Samples were transferred to evacuated vials, provided with rubber septa and aluminum seals, for later chromatography analysis.

Results

The general variation in N_2O emission rate observed indicate there was an influx of N_2O. Accumulated rates during 21 days were small and similar ($P>0.05$) in INT, SP, CL, CLF and EXT pastures (average of -7.26 g ha^{-1}) - Figure 1. The N_2O influx was more intense in the Forest (-39.74 g ha^{-1}) compared to the other systems.

The lack of N_2O emission, resulting in influx, may be explained by the fact that soils in tropical pastures are generally well drained, aerated and N deficient, impairing N_2O emission. Wood e Silver (2012) reported N_2O influx in forest with dry soil. In pastures, Whitehead (1995) observed N_2O consumption by the grass leaves.

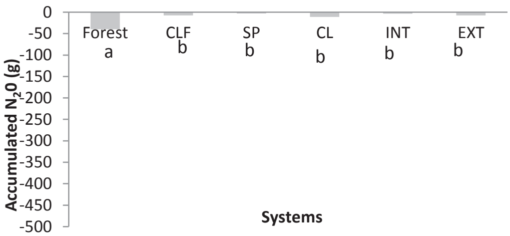

Figure 1. Accumulated N2O (Kg ha^{-1}) in the grazing systems and in the forest.
a, b: Means with different letters differ by the Tukey test ($P<0.05$).
INT: Intensive; SP: Silvopastoral; CL: Crop-livestock; CLF: Crop-livestock-forestry; EXT: Extensive.

Conclusions

Results of one season may not reflect the N_2O emission pattern of a complete production cycle. Evaluations involving all the four annual seasons are necessary to fully characterize emissions in integrated systems, the natural forest and traditional beef cattle grazing systems.

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